IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicant(s): Azadet et al.
Case: 15-7
Serial No.: 10/022,665
Filing Date: December 18, 2001
Group: 2133
Examiner: Joseph D Torres

Title: Method and Apparatus for Joint Equalization and Decoding of Multidimensional Codes Transmitted over Multiple Symbol Durations

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RESPONSE TO NOTICE OF PANEL DECISION FROM PRE-APPEAL BRIEF REVIEW

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Notice of Panel Decision from Pre-Appeal Brief Review, dated December 19, 2006, Applicants submit herewith an Appeal Brief.

Respectfully,

Date: January 18, 2007

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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
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Sir:

Applicants hereby appeal the final rejection dated June 28, 2006, of claims 1-4, 9, 10, and 21-34 of the above-identified patent application.

REAL PARTY IN INTEREST

The present application is assigned to Agere Systems Inc., as evidenced by an assignment recorded on December 18, 2001 in the United States Patent and Trademark Office at Reel 012396, Frame 0234. The assignee, Agere Systems Inc., is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

STATUS OF CLAIMS

Claims 1-4, 9, 10, and 21-34 are presently pending in the above-identified patent application. Claims 1, 21, 26, 27 and 33 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chevillat (United States Patent No. 5,031,195) in view of Kim (United States Patent No. 5,963,592) and claims 2-4, 9, 10, 22-25 and 34 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chevillat and Kim in view of Eyuboglu (United States Patent No. 4,713,829). The Examiner indicated that claims 28-32 would be allowable if rewritten in independent form. Appellants assume that the Section 112 rejection and Drawings objection have been withdrawn, since they were addressed by Appellants in the prior response and were not further addressed by the Examiner in the Advisory Action. Claims 1, 2, 4, 21, and 33 are being appealed.

STATUS OF AMENDMENTS

The amendments filed in the Amendment and Response After Final Rejection dated September 28, 2006 have been entered.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 1 is directed to a method for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality (page 4, line 14, to page 5, line 4), said method comprising the steps of: compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols (page 5, line 5, to page 11, line 16); and compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol (page 8, line 20, to page 11, line 16).

In one exemplary embodiment, the multidimensional code symbols are transmitted over more than one symbol interval that is used to transmit one of said symbol components (page 4, line 4, to page 6, line 14).

In one exemplary embodiment, the method further comprises the steps of: calculating intrasymbol interference estimates based on possible data symbol values; and

calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates (page 5, line 5, to page 11, line 6).

Independent claim 21 is directed to a system for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality (page 4, line 14, to page 5, line 4), said system comprising: means for compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols (page 5, line 5, to page 11, line 16); and means for compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol (page 8, line 20, to page 11, line 16).

Independent claim 33 is directed to a system for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality (page 4, line 14, to page 5, line 4), comprising: a decision feedback unit for compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols (page 5, line 5, to page 11, line 16); and a branch metrics unit for compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol (page 8, line 20, to page 11, line 16).

STATEMENT OF GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 21, 26, 27 and 33 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chevillat in view of Kim and claims 2-4, 9, 10, 22-25 and 34 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chevillat and Kim in view of Eyuboglu.

ARGUMENT

Independent Claims 1, 21 and 33

The Examiner rejected independent claims 1, 21 and 33 under 35 U.S.C. §103(a) as being unpatentable over Chevillat in view of Kim. With regard to claims 1 and 21, for example, the Examiner asserts that Chevillat teaches compensating for intersymbol interference caused by previously transmitted multidimensional code symbols (citing Abstract and col. 5,

lines 8-17 and 46). The Examiner acknowledges that Chevillat does not explicitly teach the use of taking specific compensatory actions for intrasymbol interference. The Examiner asserts, however, that Kim teaches compensation for intrasymbol interference (citing col 9, lines 8-13).

In order to simplify the issues that are presented for appeal, Appellants submit that neither Chevillat nor Kim, separately or in combination, disclose or suggest compensating for ***intra***symbol interference caused by symbol components within a current multidimensional code symbol.

Patentable Weight of "Multidimensional Code Symbol" Definition

In the Advisory Action, the Examiner asserts that the preamble language "a multidimensional code symbol comprises a number of symbol components of lower dimensionality," should not be given patentable weight, because the recitation occurs in the preamble To the contrary, however, the above quoted limitation "...caused by symbol components within a current multidimensional code symbol," must be interpreted in light of the preamble. The term "multidimensional code symbol" is defined in the preamble to comprise "a number of symbol components of lower dimensionality," and thus, this recitation **must** be given patentable weight.

Despite the comments of the Examiner in the Advisory Action, the preamble recitation "a number of symbol components of lower dimensionality," does not merely recite the purpose of a process or the intended use of a structure. In fact, the body of the claim most certainly depends on the preamble for completeness. Thus, the Examiner's own cited case law is not even applicable. There is no basis in law or fact for overlooking the explicit definition of the term "multidimensional code symbol," in the manner suggested by the Examiner.

Intrasymbol Interference Compensation

Independent claims 1, 21 and 33 require compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol. In the final Office Action, the Examiner asserts that Kim teaches compensation for intrasymbol interference (citing col. 9, lines 8-13).

In the Advisory Action, the Examiner did not address the issue of ***intra***symbol interference at all, and failed to address any of Appellants' remarks with respect to ***intra***symbol interference.

Appellants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness for at least the reason that there exists no motivation to combine the references, and further, even if combinable, the references collectively do not teach each and every limitation of the independent claims. See, e.g., M.P.E.P. §2143. Also, there is no reasonable expectation of success. *Id.*

Appellants submit that the references, when combined, do not disclose or suggest compensating for intrasymbol interference caused by symbol components within a current multidimensional **code** symbol. As indicated by Appellants in at least two prior responses (but, again, *not addressed at all by the Examiner in the latest Office Action or Advisory Action*), ***Kim is not even directed to a coded system!*** Thus, Kim does not disclose or suggest compensating for **intra**symbol interference within multidimensional **code** symbols. Kim defines intrasymbol interference in the context of in-phase and quadrature-phase filtering in an OFDM transceiver without consideration of coding. Appellants **again** respectfully request the Examiner to specifically identify any suggestion of a multidimensional code in Kim.

Appellants further submit that there exists no motivation to combine the references. The Examiner asserts that it would be obvious to modify Chevillat with the teachings of Kim by including the use of taking specific compensatory actions for intrasymbol interference, because one of ordinary skill in the art would have recognized that such compensatory actions would have provided adaptation for abrupt changes in the channel.

First, since Kim is not even directed to a coded system, a person of ordinary skill in the art would not even look to Kim for a solution to the problem addressed by the present invention, namely, the decoding of multidimensional codes. Thus, a person of ordinary skill would not combine Chevillat and Kim.

Second, the Examiner seems to rely on the general notion that "intersymbol and intrasymbol interference are a type of noise due to multi-path fading, causing errors in the received data," in support of a motivation to combine. Appellants note, however, that intersymbol and intrasymbol interference are distinct and independent types of channel impairments, each requiring specific treatment. A solution that compensates for intersymbol interference does not suggest a solution that compensates for intrasymbol interference, and vice versa.

Also, there is no reasonable expectation of success for the combination of Chevillat and Kim. Kim suggests to "to remove intrasymbol interferency by updating the in-phase and quadrature phase filtering coefficients by utilizing the pilot signal," which is different from "compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol." Kim addresses the removal of intrasymbol interference for an uncoded symbol comprising I and Q coordinates, whereas claim 1 addresses the compensation of intrasymbol interference caused by symbol components within a current multidimensional code symbol. It is not clear to Appellants how the removal of in-phase and quadrature-phase filtering coefficients by utilizing the pilot signal leads to the compensation of intrasymbol interference caused by symbol components within a current code symbol. Therefore, there is no reasonable expectation of success.

Thus, Appellants respectfully request withdrawal of the Section 103 rejection of the independent claims.

Claims 2 and 4

Claims 2 and 4 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chevillat and Kim in view of Eyuboglu. Regarding claim 2, the Examiner acknowledges that Chevillat and Kim do not explicitly teach the specific use of multidimensional Trellis code constellations, but asserts that Eyuboglu teaches this limitation (col. 8 and 4D Block Encoder 97 in FIG. 7). Regarding claim 4, the Examiner asserts that Eyuboglu teaches calculating intersymbol interference estimates based on said previously decoded multidimensional code symbols (col. 4, lines 61-65, in Eyuboglu) and calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates (col. 3, lines 1-2, in Eyuboglu); and that Kim teaches calculating intrasymbol interference estimates based on possible data symbol values (col. 9, lines 8-13, in Kim).

Appellants again respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness for at least the reason that there exists no motivation to combine the references, and further, even if combinable, the references collectively do not teach each and every limitation of the independent claims. Appellants could find no disclosure or suggestion in the cited references to combine the techniques of Eyuboglu with the inventions of either

Chevillat or Kim. Claim 2 requires wherein multidimensional code symbols are transmitted over more than one symbol interval that is used to transmit one of said symbol components and claim 4 requires calculating intrasymbol interference estimates based on possible data symbol values; and calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates.

Thus, Chevillat, Kim, and Eyuboglu, alone or in any combination, do not disclose or suggest wherein multidimensional code symbols are transmitted over more than one symbol interval that is used to transmit one of said symbol components, as required by claim 2, and do not disclose or suggest calculating intrasymbol interference estimates based on possible data symbol values; and calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates, as required by claim 4.

Conclusion

The rejections of the cited claims under section 103 in view of Chevillat, Kim, and Eyuboglu, alone or in any combination, are therefore believed to be improper and should be withdrawn. The remaining rejected dependent claims are believed allowable for at least the reasons identified above with respect to the independent claims.

The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully,

Date: January 18, 2007

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APPENDIX

1. A method for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality, said method comprising the steps of:

compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols; and

compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol.

2. The method of claim 1, wherein multidimensional code symbols are transmitted over more than one symbol interval that is used to transmit one of said symbol components.

3. The method of claim 1, wherein said multidimensional code symbol comprises a number of transmitted symbol components of lower dimensionality that exceeds a number of available channels.

4. The method of claim 1, further comprising the steps of:

calculating intrasymbol interference estimates based on possible data symbol values; and

calculating branch metrics based on a received signal and said intersymbol interference and intrasymbol interference estimates.

5. (Cancelled).

6. (Cancelled).

7. (Cancelled)

8. (Cancelled).

9. The method of claim 1, further comprising the step of determining a best surviving path into a trellis state.

10. The method of claim 1, wherein said multidimensional code is 4D-TCM.

11-20. (Cancelled)

21. A system for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality, said system comprising:

means for compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols; and

means for compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol.

22. The method of claim 1, further comprising the step of calculating a metric for an initial symbol component using survivor symbols from a corresponding state to account for intersymbol interference, wherein said metric is used for the calculation of a branch metric.

23. The method of claim 22, further comprising the step of calculating a metric for a subsequent symbol component using survivor symbols from a corresponding state to account for intersymbol interference and using at least one data estimate to account for intrasymbol interference.

24. The method of claim 23, further comprising the step of calculating a combined metric by combining said metric for said initial symbol component and said metric for said subsequent symbol component.

25. The method of claim 24, further comprising the step of computing a branch metric for a transition in a trellis using said combined metric.

26. The method of claim 1, further comprising the step of calculating an intersymbol interference-free estimate using at least one survivor symbol from a survivor path.

27. The method of claim 26, wherein said intersymbol interference-free estimate is computed for a first and a subsequent symbol interval.

28. The method of claim 27, further comprising the step of calculating an intersymbol interference and intrasymbol interference-free estimate based on said intersymbol interference-free estimate for said subsequent symbol interval and a data symbol that was determined based on said intersymbol interference-free estimate for said first symbol interval.

29. The method of claim 28, further comprising the step of computing a distance metric for said first symbol interval based on said intersymbol interference-free estimate for said first symbol interval.

30. The method of claim 29, further comprising the step of computing a distance metric for said subsequent symbol interval based on said intersymbol interference and intrasymbol interference-free estimate.

31. The method of claim 30, further comprising the step of computing a branch metric for a transition in a trellis based on said distance metrics for said first and subsequent symbol intervals.

32. The method of claim 31, further comprising the step of computing the best path into a state in said trellis.

33. A system for decoding a multidimensional code, wherein a multidimensional code symbol comprises a number of symbol components of lower dimensionality, comprising:

a decision feedback unit for compensating for intersymbol interference caused by previously transmitted multidimensional code symbols by calculating intersymbol interference estimates based on one or more multidimensional code symbols; and

a branch metrics unit for compensating for intrasymbol interference caused by symbol components within a current multidimensional code symbol.

34. The system of claim 33, wherein said multidimensional code symbol comprises a number of transmitted symbol components of lower dimensionality that exceeds a number of available channels.

EVIDENCE APPENDIX

There is no evidence submitted pursuant to § 1.130, 1.131, or 1.132 or entered by the Examiner and relied upon by appellant.

RELATED PROCEEDINGS APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 CFR 41.37.